

# A LIGHT-EMITTING DIODE EMITTING UNIFORMLY LIGHT ALL AROUND

## BACKGROUND OF THE INVENTION

### Field of Invention

5       The present invention relates in general to a light-emitting diode (LED), and more particular, to a light-emitting diode operative to emit uniform light to the ambient thereof.

### Related Art

10       The further technical advancement and the inherent features such as low driving voltage, low heat, and uneasily broken structure have acquired broader application in various types of lighting devices, particularly the decorative lamps. The commonly used light-emitting diode includes a light-emitting diode chip encapsulated within a transparent or translucent casing. The casing is configured to provide converging effect. Therefore, the light is typically concentrated within a narrow viewing angle. The light is very dim for the observer positioning beyond the narrow viewing angle. To resolve the narrow  
15       viewing angle problem, different configurations of the casing such as wedge or polygonal have been proposed. The configuration with wedged surface allow the light generated by the light-emitting diode to reflect towards specific angle. However, the majority of light is still concentrated upfront. The lateral light is still very limited. In Chinese Patent No. ZL98248949, glass beads are added within the casing for a light-emitting diode envelop  
20       body to cause the light reflected laterally. However, as the density of the glass beads is different from that of epoxy used for fabricating the casing, the glass beads are often non-uniformly distributed within the casing to result in non-uniform light. In addition, this type of light-emitting diode device is laborious and more costly.

## SUMMARY OF THE INVENTION

25       A light-emitting diode device is provided to generate uniform light with large viewing angle. The light-emitting as provided has a simple structure, such that the process

complexity and cost are greatly reduced.

The light-emitting diode device of the present invention is fulfilled as follows.

The light-emitting diode device includes a light-emitting diode chip, a transparent envelop body, a connection pin, which is characterized in that the top of the envelop body  
5 forms an inward concave.

The shape of the envelop body or the inward concave can be changed as desired. For example, the envelop body can be formed as a cylindrical body and the inward concave can be formed as a conic or a semi-spherical concave with an angle around  $100^{\circ}$  to  $160^{\circ}$ .

Color envelop body can be used to provide desired visual effect.

10 By configuring the indented top surface of the envelop body into the inward concave structure, the light generated by the light-emitting diode chip is properly deflected, reflected and diffused into a uniform light emitted with a wide angle. The cylindrical body and the indented top surface can be easily fabricated with much lower cost. More important, the light-emitting diode device adapting such envelop body is operative to  
15 generate light propagating both forwardly and laterally, such that the observer at the side of the light-emitting diode device can easily observe the light generated thereby, while the observer right in front of the light-emitting diode device will not be dashed by the concentrated light.

## BRIEF DESCRIPTION OF THE DRAWINGS

20 The present invention will become more fully understood from the detailed description given hereinbelow illustration only, and thus are not limitative of the present invention, and wherein:

FIG. 1 shows a perspective view of a light-emitting diode device according to the present invention;

25 FIG. 2 shows a top view of the light-emitting diode device as shown in Figure 1;

FIG. 3 shows a cross sectional view of the light-emitting diode device along the A-A line in Figure 2;

FIG. 4 shows the propagation of light generated by the light-emitting diode device; and

FIG. 5 shows a light-emitting diode device includes various color light-emitting diode chips to emit blue or white color of light.

## DETAILED DESCRIPTION OF THE INVENTION

As shown in Figures 1 and 3, the light-emitting diode device includes a light-emitting diode chip 1, connection pins 3 and a transparent envelop body 2 for encapsulating the light-emitting diode chip 1 therein. The connection pins 3 extend from the light-emitting diode chip 1 through the envelop body 2 to provide electric connection to an external device such as a power source. The envelop body 2 can be fabricated from epoxy, for example. As shown, the internal ends of connection pins 3 are terminated with electrode frames 31 to prevent the connection pins 3 separately from engaging with the envelop body 2. The electrode frames 31 form a recessed space 311 for accommodating the light-emitting diode chip 1 therein to provide more forward focused light beam. The frames 31 include conductive wires for connecting the light-emitting diode chip 1. As shown in Figure 4, in order to satisfy user's need to emit light uniformly all around and to enhance decorative effects, the envelop body 2 has the top surface being indented. It skillfully makes use of the optical spreading characteristic of the inward concave so that light beam straightly emitted by the light emitting diode chip 1 toward the envelop body 2 will uniformly emit all around the envelop body 2 via refraction of a plurality of the sides of the inward concave. The envelop body 2 can be different kind of shape such as a cylindrical body or a semi-spherical body. The shape of the indented top surface can be changed as desired, for example, an inward concave 21. The inward concave 21 can be formed as a conic concave 21 or a polygonal concave. Alternatively, the top surface can be indented into a semi-spherical recess. As shown in Figure 3, to ensure the better performance, a curvature of the inward concave 21 can not be too small or too large; otherwise, light beam straightly emitted from the light emitting diode chip 1 will direct

forwardly without sufficient light deflecting, reflecting and diffusing all around so that the lighting effect of the present invention is reduced. Therefore, an angle of the curvature is between  $100^{\circ}$  to  $160^{\circ}$ , preferably, between  $130^{\circ}$  to  $140^{\circ}$  to optimize the uniformity. Further, the envelop body 2 can be made with various colors to provide desired visual effect. Figure 3 shows the structure for the light-emitting diode device which provides any color of light except for blue or white color. Figure 5 shows a modification of the light-emitting diode device in which more than one light emitting diode chips are installed to generate blue or white color of light. Accordingly, it can emit light all around, and which has a simple structure, easy to manufacture, low manufacturing cost, good decorative effect. Thus, it can be applied to in the field of all sorts of new type lamps.